

CLAIMS

1. A liquid crystal display device comprising:

a pair of substrates substantially parallel to each other, at least one of the substrates being transparent; and

5 a liquid crystal layer sandwiched and held between the substrates,

wherein a plurality of pixels each constituted by parts of the respective substrates and a part of the liquid crystal layer sandwiched between the parts of the substrates are arranged in a matrix pattern,

each of the pixels includes first and second electrodes for generating, between the
10 substrates, an electric field in a direction substantially parallel to the substrates and is divided into a plurality of regions,

the regions of each of the pixels are defined by the first and second electrodes,

the direction of an electric field generated in one of the regions is opposite to that of an electric field generated in an adjacent one of the regions, and

15 the liquid crystal layer has a structure in which when no electric field is generated, a slow axis indicating a refractive-index anisotropy as viewed in a direction normal to the substrates in each of the regions is vertical or parallel to the direction in which an electric field is to be generated whereas when an electric field is generated, the slow axis rotates about an axis normal to the substrates and slow axes in adjacent ones of the regions rotate
20 in opposite directions.

2. The device of claim 1, wherein polarization is present in the liquid crystal layer when no electric field is generated between the first and second electrodes.

25 3. The device of claim 2, wherein a component of an average polarization direction

in a direction parallel to the substrates is orthogonal to the direction in which an electric field is to be generated, when no electric field is generated between the first and second electrodes.

5 4. The device of claim 2, wherein the polarization in the liquid crystal layer is caused by a flexoelectric effect.

5. The device of claim 1, wherein the liquid crystal layer contains liquid crystal molecules having a pretilt angle with respect to at least the interface between the liquid
10 crystal layer and one of the substrates.

6. The device of claim 5, wherein a direction obtained by projecting a pretilt direction of the liquid crystal molecules is orthogonal to the direction of an electric field generated between the first and second electrodes.

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7. The device of claim 5, wherein the pretilt angle of the liquid crystal molecules is defined by one of a rubbing process and a photo-alignment process.

8. The device of claim 5, wherein the liquid crystal molecules have pretilt angles
20 with respect to both of the interface between the liquid crystal layer and one of the substrates and the interface between the liquid crystal layer and the other substrate, and
directions obtained by projecting pretilt directions of the liquid crystal molecules onto the respective substrates are identical.

25 9. The device of claim 1, wherein the first and second electrodes are driven such

that potential levels of the respective first and second electrodes alternate with each other.

10. The device of claim 1, wherein each of the pixels includes a switching element for driving the liquid crystal layer, signal lines and scanning lines,

5 the signal lines and the scanning lines are connected to the switching element and arranged in a lattice pattern, and

 the first and second electrodes extend in parallel with the signal lines or the scanning lines.

10 11. The device of claim 1, wherein the first and second electrodes are alternately arranged.

 12. The device of claim 1, wherein at least part of the periphery of an electrode group composed of the first and second electrodes is constituted by opposed electrodes
15 connected to a common line.

 13. The device of claim 1, wherein the liquid crystal layer is driven at a frequency that is an even multiple of a frame frequency of a video signal, and

 a period in which the liquid crystal layer is driven by a positive electric field is
20 equal to a period in which the liquid crystal layer is driven by a negative electric field.

 14. The device of claim 1, wherein a pulse voltage applied to the liquid crystal layer is set at zero temporarily at every vertical synchronization period of a video signal.

25 15. The device of claim 1, wherein a pulse voltage applied to the liquid crystal

layer in a vertical synchronization period of a video signal has a polarity opposite to that of a signal voltage applied to the liquid crystal layer in the same vertical synchronization period, at every vertical synchronization period.

5 16. The device of claim 1, wherein the liquid crystal layer is in the state of a splay orientation.

 17. The device of claim 1, wherein the liquid crystal layer is in the state of a bend orientation.

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 18. The device of claim 1, wherein the liquid crystal layer is in the state of a hybrid orientation.

 19. The device of claim 1, wherein a dielectric-constant anisotropy of the liquid
15 crystal layer has an absolute value of three or less.

 20. The device of claim 1, wherein a dielectric-constant anisotropy of the liquid crystal layer has an absolute value of one or less.

20 21. A method for driving the liquid crystal display device of claim 1, wherein the first and second electrodes are driven such that potential levels of the respective first and second electrodes alternate with each other.

 22. A method for driving the liquid crystal display device of claim 1, wherein the
25 liquid crystal layer is driven at a frequency that is an even multiple of a frame frequency of

a video signal, and

a period in which the liquid crystal layer is driven by a positive electric field is equal to a period in which the liquid crystal layer is driven by a negative electric field.

5 23. A method for driving the liquid crystal display device of claim 1, wherein a pulse voltage applied to the liquid crystal layer is set at zero temporarily at every vertical synchronization period of a video signal.

 24. A method for driving the liquid crystal display device of claim 1, wherein a
10 pulse voltage applied to the liquid crystal layer in a vertical synchronization period of a video signal has a polarity opposite to that of a signal voltage applied to the liquid crystal layer in the same vertical synchronization period, at every vertical synchronization period.